Big Data in HPC

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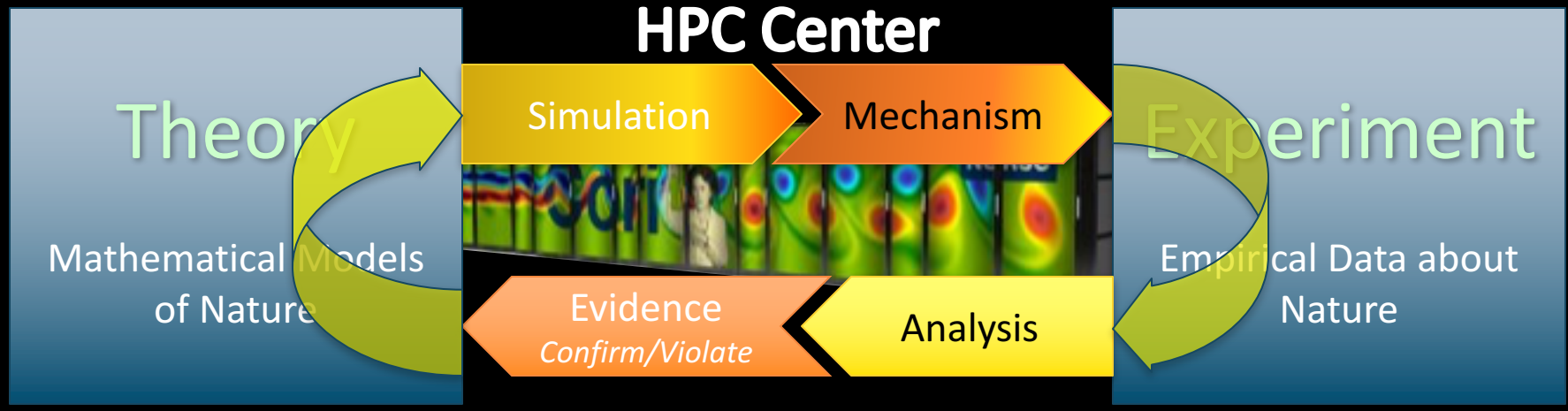
Evolving Role of Supercomputing Centers

- Traditional Pillars of science
  - ***Theory***: mathematical models of nature
  - ***Experiment***: empirical data about nature

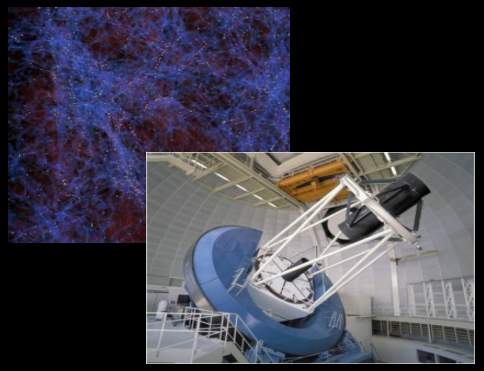
- Scientific computing connects theory to experiment
  - Computational models are used to test theories involving complex phenomena that cannot be matched directly against experiments
  - Enable comprehension of complex experimental data by distilling *complex data* down to *understandable information*
- *There is no scientific "discovery" without a theory about underlying mechanism*
- *There is no scientific "discovery" without experimental validation of model*



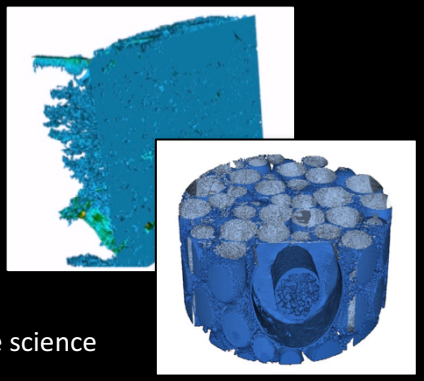
Breakthrough science will occur at the interface of observation and simulation

Materials and Chemistry

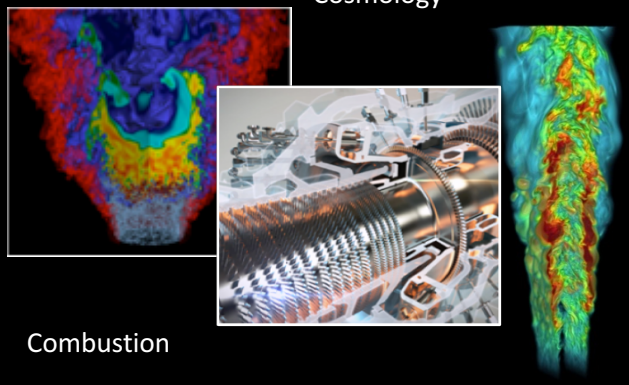
Environment and Climate



Cosmology



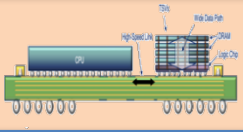
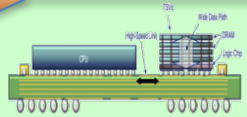
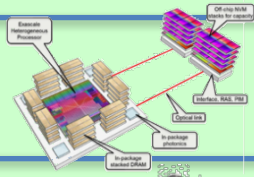
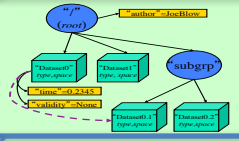
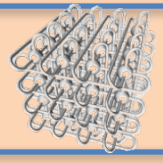
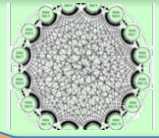
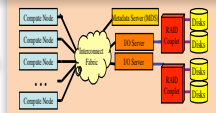
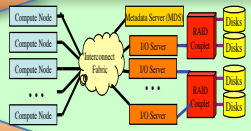
Subsurface science



Combustion

New research challenges to make these work together

Data Intensive Arch for 2017 (*as imagined in 2012*)

	Compute Intensive Arch	Data Intensive Arch
Compute	 5TF/socket 1-2 sockets	 + + 5TF/sock 8+ sockets
	1TB/s	
On-Package DRAM	 64-128GB HMC or Stack	 1-4 TB Aggregate Chained-HMC
	200TB/s	
Capacity Memory	 .5-1TB CDIMM (opt.)	 5-10TB Memory Class NVRAM
	100TB/s	
On-node-Storage	**n.a.**	 10-100TB SSD Cache or local FS
	50GB/s/node 10TB/s/rack	
In-Rack Storage	 Organized for Burst Buffer	 1-10PB Dist.Obj. DB (e.g whamcloud)
	50GB/s inject 10TB/s bisect	
Interconnect	 Spatially-oriented e.g. 3D-5D Torus	 All-to-All oriented e.g. Dragonfly or 3T
	50GB/s inject 0.5TB/s aggregate	
Global Shared Disk	 ~1% nodes for Storage Gateways	 ~10-20% nodes for Storage Gateways
	4GB/s per node	
Off-System Network	~1% nodes for IP Gateways	40GBe Ethernet to Direct from each node

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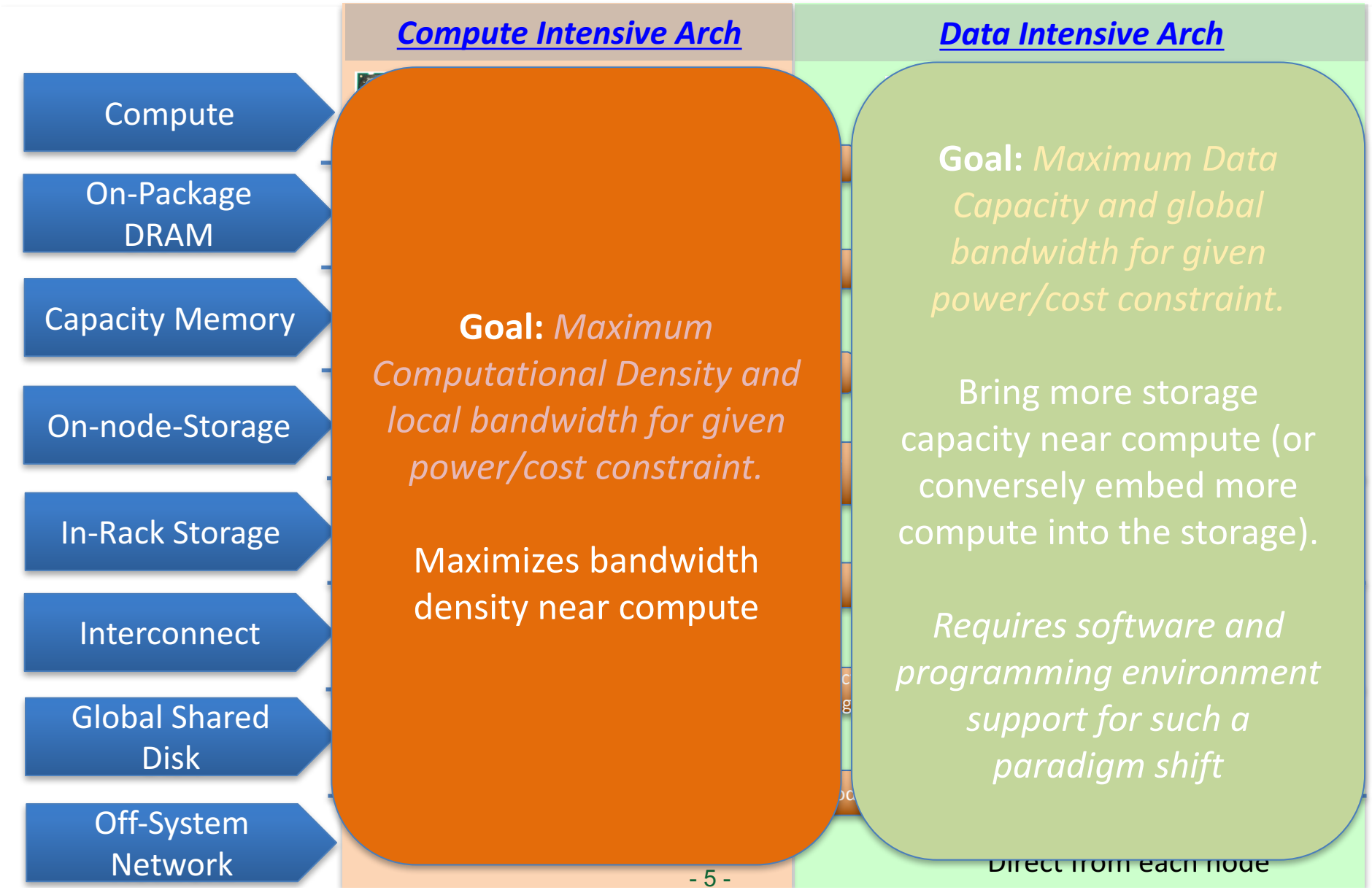


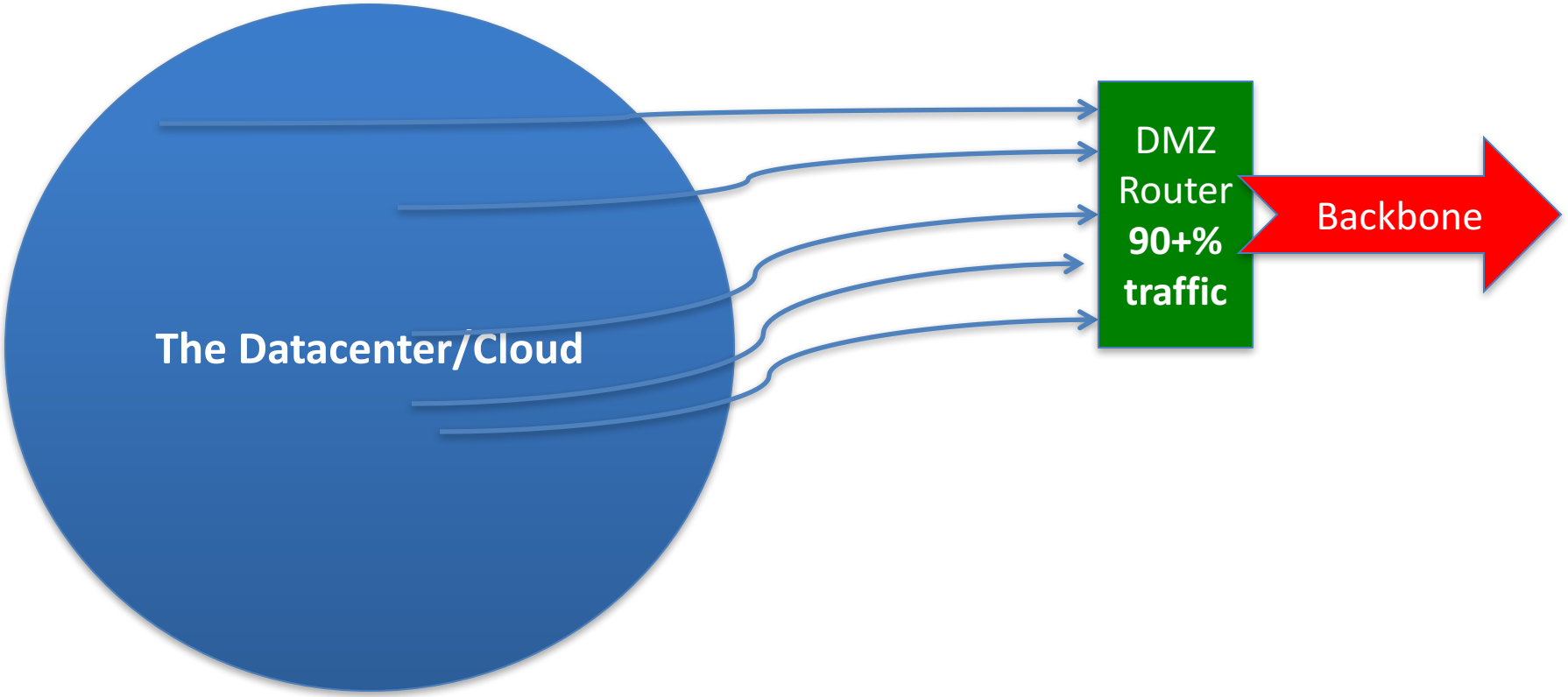
Old/New Conception of Cloud/Datacenters

(Simplified Conceptual Model of Interconnect Convergence)

Old Conception

Designed for externally facing TCP/IP

Nearly 100% Std. TCP/IP ethernet inside and out



Old/New Conception of Cloud/Datacenters

(Simplified Conceptual Model of Interconnect Convergence)

New Conception

Need to Handle Internal Data Mining/Processing

Design for 80+% internal traffic